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CALCULATION OF A PAIR CORRELATION FUNCTION FOR THE THREE-DIMENSIONAL ISING MODEL WITH LONG-RANGE EXCHANGE FORCES

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A simple difference equation for one type of correlators has been obtained by the method of direct calculation of the correlation functions (CF). It is correct for the Ising model of an arbitrary dimension with the exactness $O(1/z)$ (z–number of particles covered by the interaction potential). The equation obtained is used to calculate the pair CF $\langle S_i^z S_j^z \rangle$ in the three-dimensional Ising model with long-range forces which are of importance when dealing with the applied magnetic problems. The results of the calculations lead to corrections in the Ornstein–Zernike (OZ) theory.

1. Introduction

The Ising model which admits the exact solution for the one- and two-dimensional systems may be taken as a standard for various quantum statistic methods. Mostly, the attempts to obtain the exact solution were concentrated on the short-range model although the model with the long-range exchange is of certain interest too. Though, as was known long ago[1]), such a model leads to the mean field approximation for magnetization, the correct CF calculation for the Ising model with $d = 3$ was not carried out and, so, the calculation of the pair CF in a three-dimensional system is based on the OZ theory[1]) and its various modifications. Not having the possibilities to consider all previous Ising problem solution methods, we will mention the simplest method of obtaining the exact solutions for the CF based on the motion equation for the spin Green functions (GF)[2,3]). In ref. 4, using this approach, the so-called far-bond equation (FBE) for one type of correlators was obtained and its solution allowed to calculate the CF of any order for a linear chain with nearest neighbour interaction. The attempts to obtain the FBE in the Ising model with $d = 2, 3$ failed and, so, for the two-dimensional model more complicated methods were used[5]).

In the present paper the Ising model with long-range exchange is considered. As an example of such forces the averaged dipole–dipole interaction and screened Coulomb interaction were chosen as representing a certain

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